Open for Science

Dr. Kevin Moerman

PhD MSc BEng, Senior Member IEEE

NUI Galway
OÉ Gaillimh

Lecturer Biomedical Engineering

Massachusetts Institute of Technology

Research Affiliate

mit media lab

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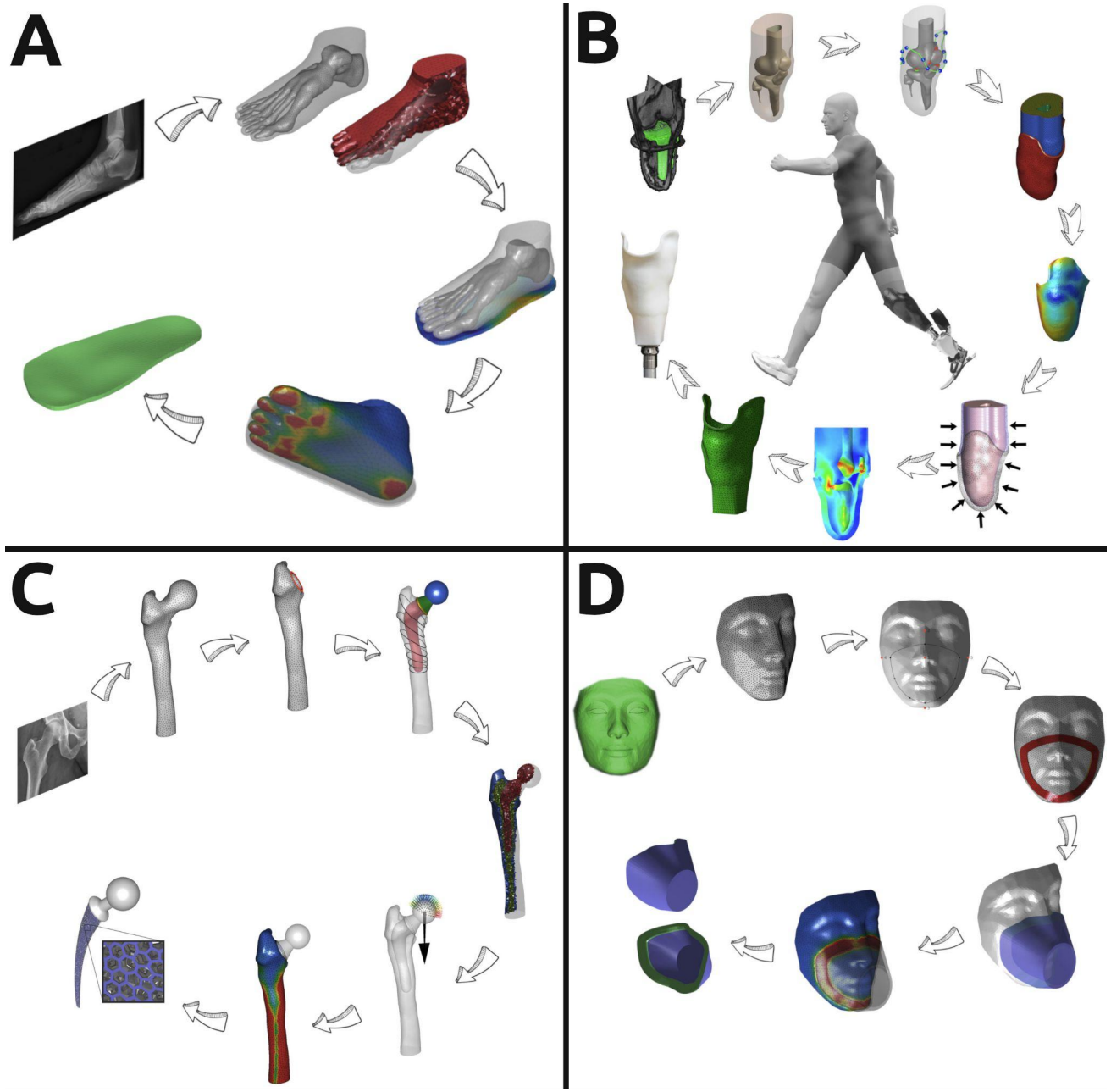
kevin.moerman@nuigalway.ie

@KMMoerman

@Kevin-Mattheus-Moerman

Frameworks for computational medical device design



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The GIBBON project

gibboncode.org

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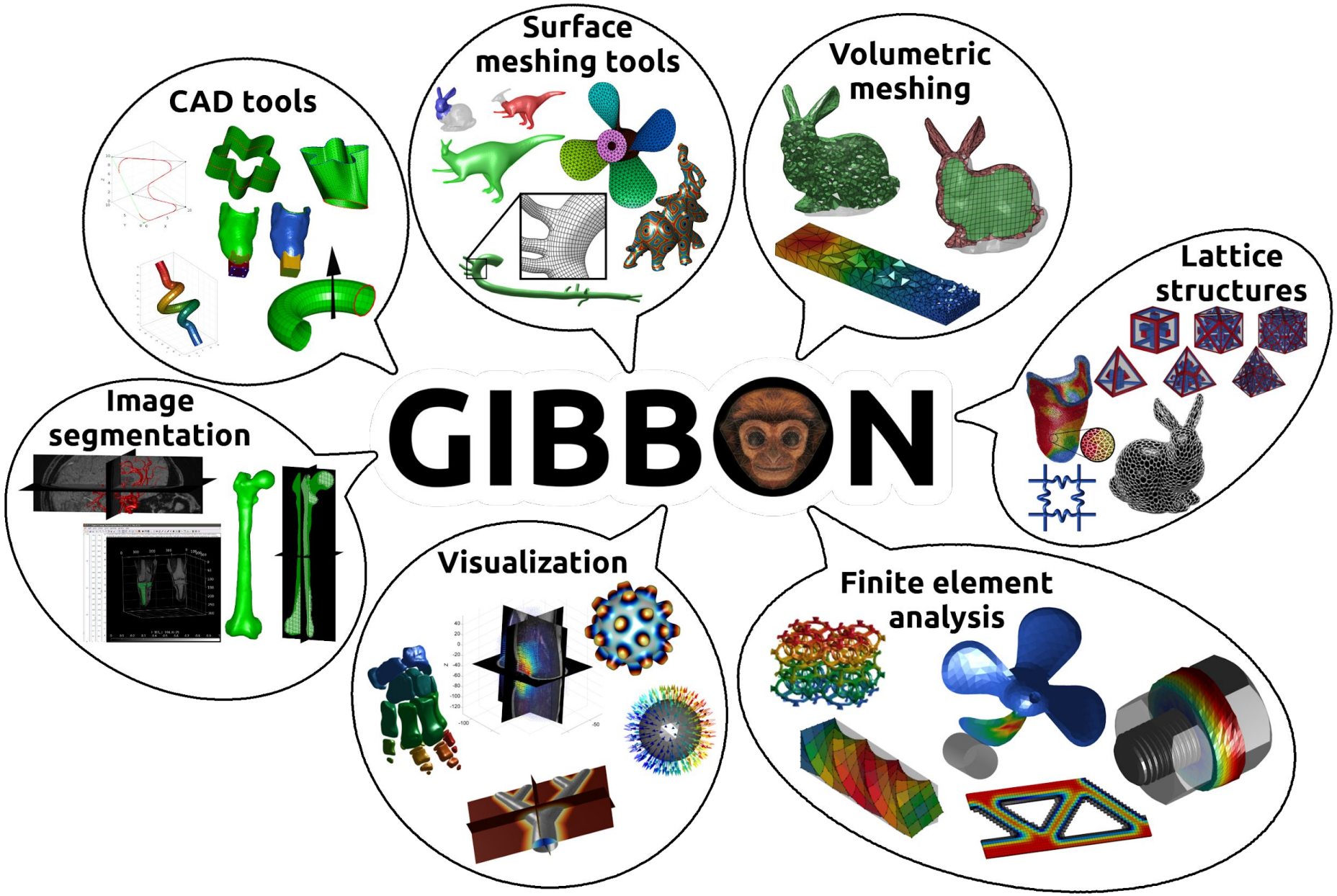

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@KMMoerman

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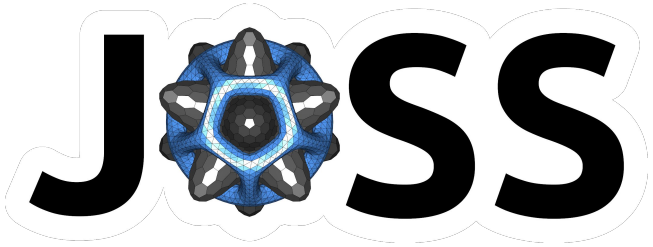
Open science advocacy

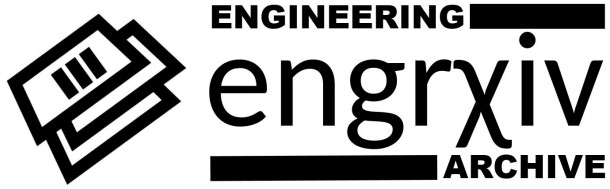
lero THE IRISH SOFTWARE RESEARCH CENTRE

Co-founder and Associate Editor in Chief
[The Journal of Open Source Software (JOSS)]



Academic Editor
[https://journals.plos.org/plosone/]

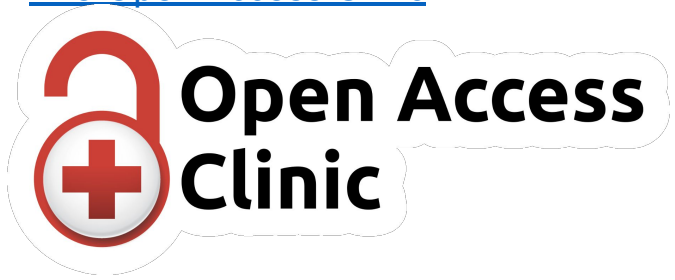
Steering committee member:
The Engineering Archive



Topic Editor
[The Journal of Open Hardware (JOH)]

Co-founder/Member:
Open Scholarship Community Galway
[http://osc-galway.ie/]

Creator:
The Open Access Clinic



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Open for Science

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- **Why do we need open science?**
- **Why is open science good for my career?**
- **How to be an open scientist?**

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Notes

- I am likely **behind** on the latest developments
- For the purposes of this talk **open science = open scholarship**
- I offer a **recommended approach** and some recommended tools. There are lots of resources and other tools available. Have a look yourself too.
- Although I comment on licenses, I am **not a lawyer** and not an expert on them! Always study licenses and their implications carefully!

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The definition of “science”

Science

From Wikipedia, the free encyclopedia

This article is about a branch of knowledge. For other uses, see Science (disambiguation).

Science (from the Latin word *scientia*, meaning "knowledge")[1] is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe.[2][3][4]

https://en.wikipedia.org/wiki/Science

The definition of “science”

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- **Builds** and **organizes knowledge** in the form of **testable** explanations/predictions

- In other words:
  - Generating knowledge
  - Communicating and sharing that knowledge
  - Testable, reproducible, verifiable

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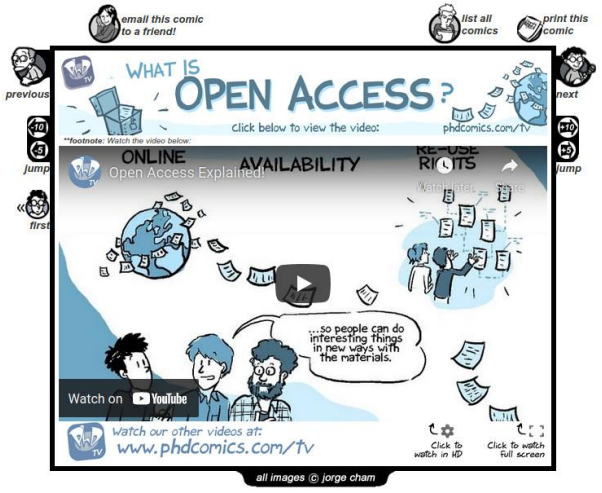
Science and “organizing knowledge”



http://phdcomics.com/comics.php?f=1533

The History of the model is that publishing scientific manuscripts was...

...expensive.

If you wanted your article distributed widely, you sent it to a journal.

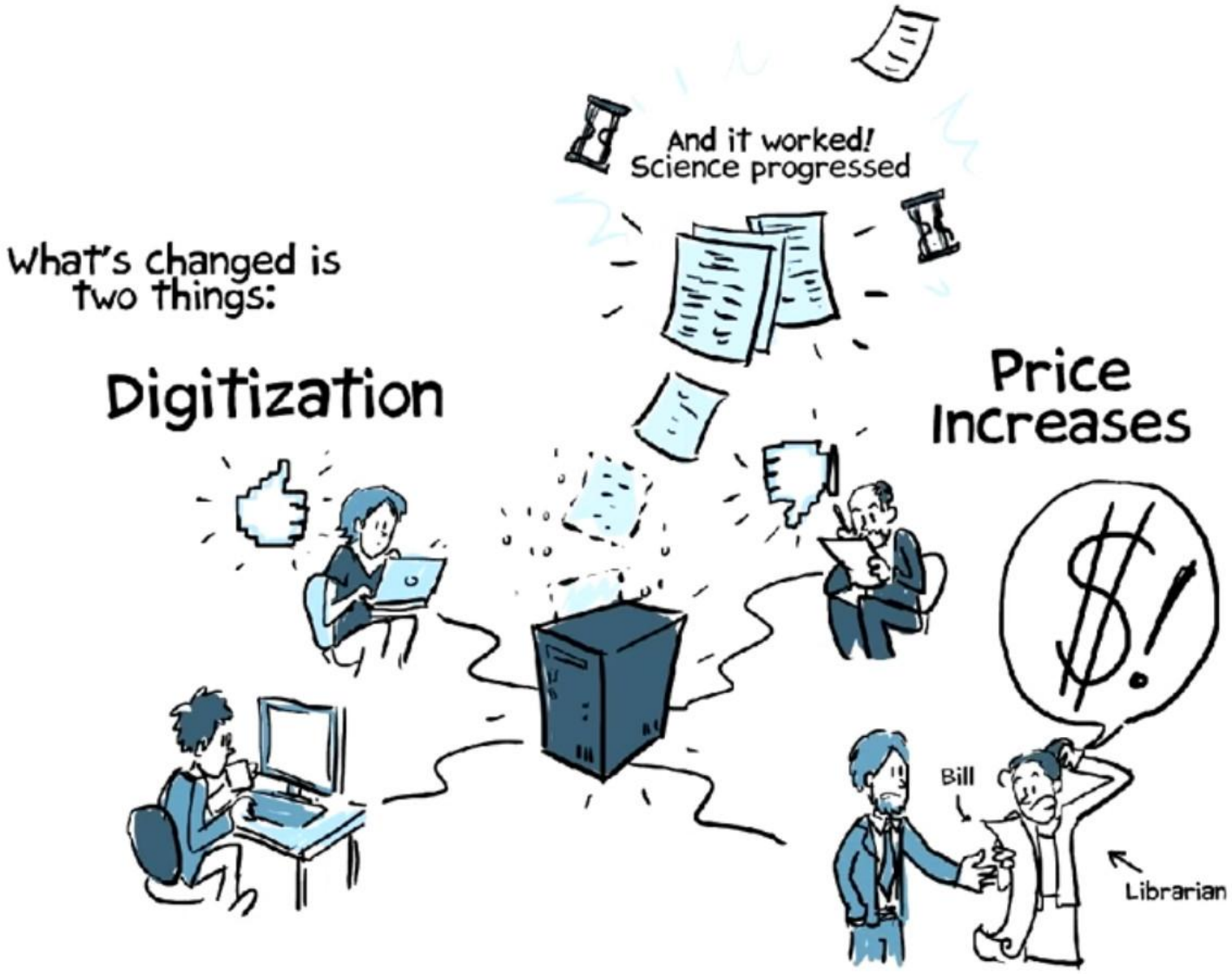
https://www.opensocietyfoundations.org/explainers/what-open-access

kevin.moerman@nuigalway.ie
@KMMoerman
@Kevin-Mattheus-Moerman

Science and “organizing knowledge”

https://www.opensocietyfoundations.org/explainers/what-open-access

Science and “organizing knowledge”



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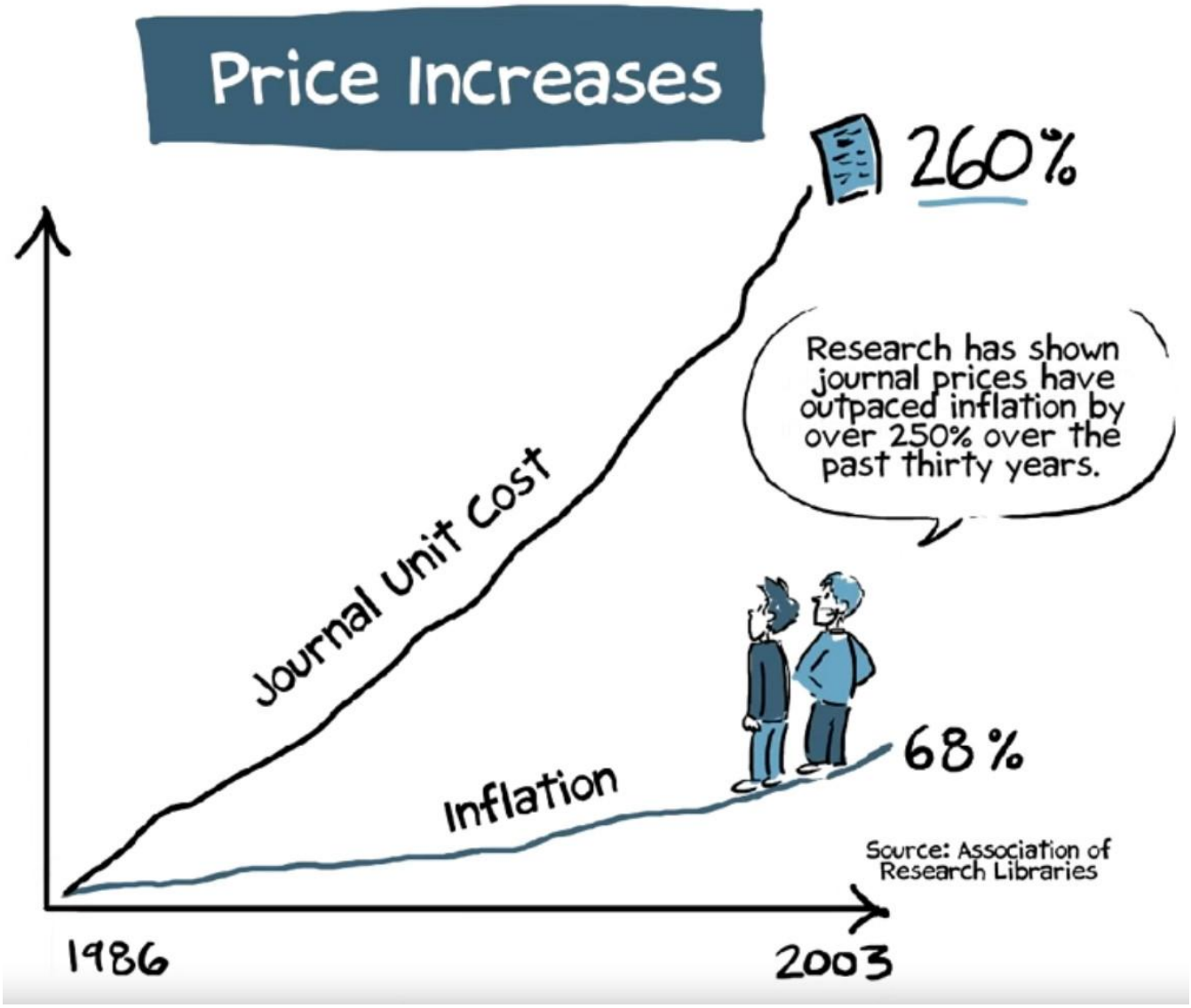
Science and “organizing knowledge”



https://www.opensocietyfoundations.org/explainers/what-open-access

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Science and “organizing knowledge”

https://www.opensocietyfoundations.org/explainers/what-open-access

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Science and “organizing knowledge”

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```
Tax payers -> government -> funding agencies -> scientists -> journals -> paywalled ....
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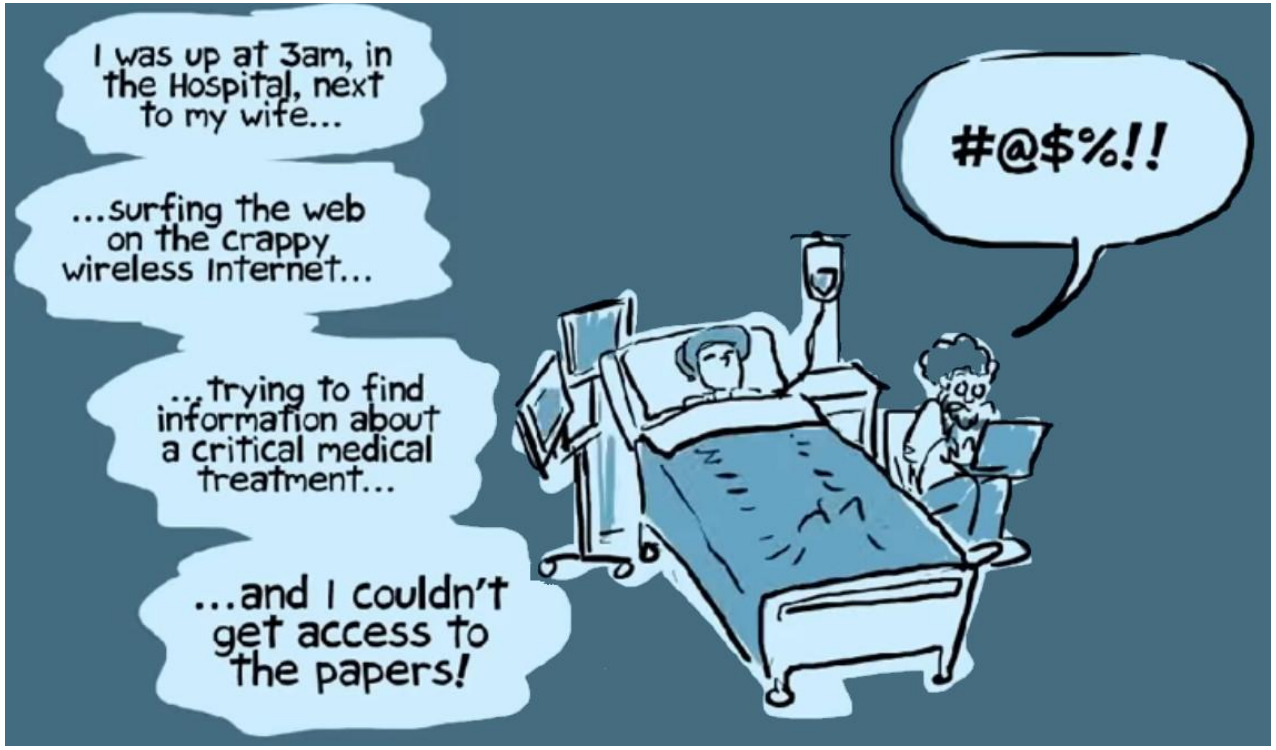

https://www.opensocietyfoundations.org/explainers/what-open-access

https://whoneedsaccess.org/

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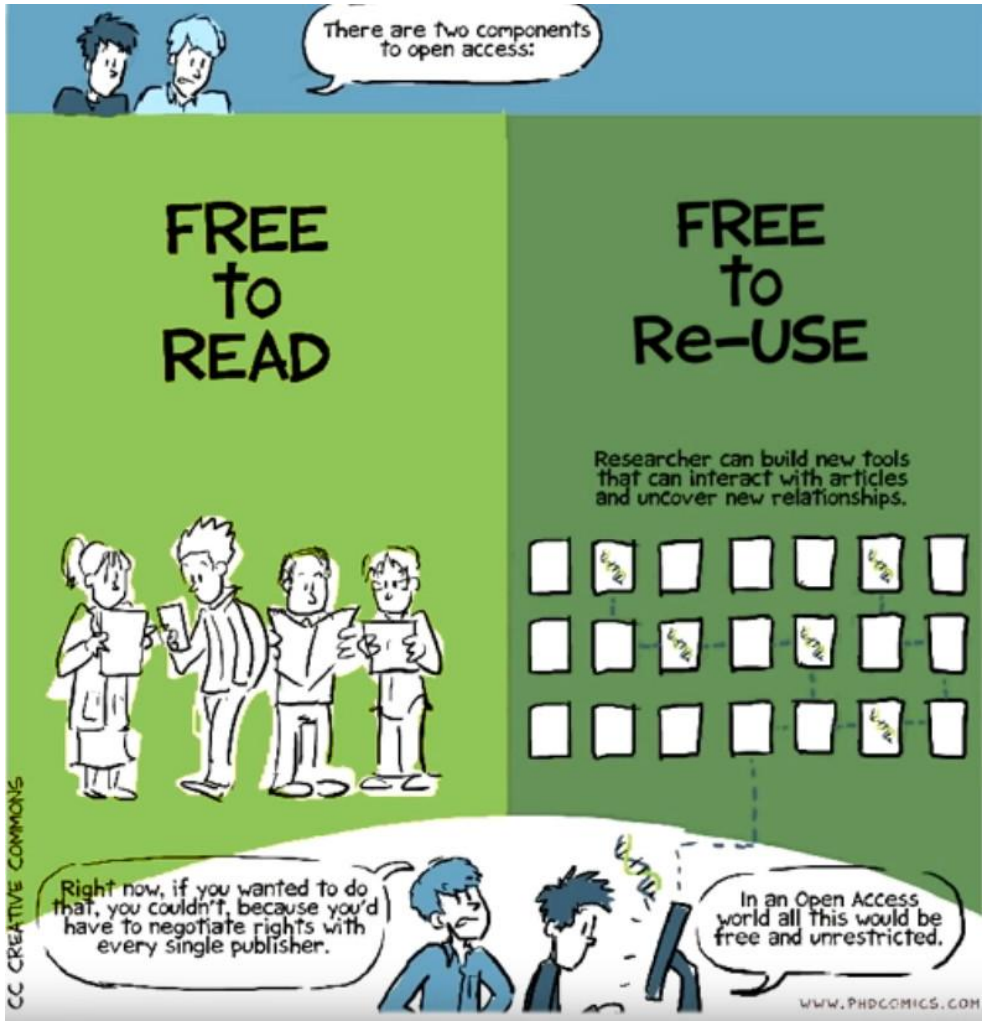
Science and “organizing knowledge”

- Licenses set permissions for use and re-use
- Standardized and open API’s enable **data mining**
- Enabling **data mining** is very important e.g. drug discovery



https://www.opensocietyfoundations.org/explainers/what-open-access

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https://xkcd.com/2456/

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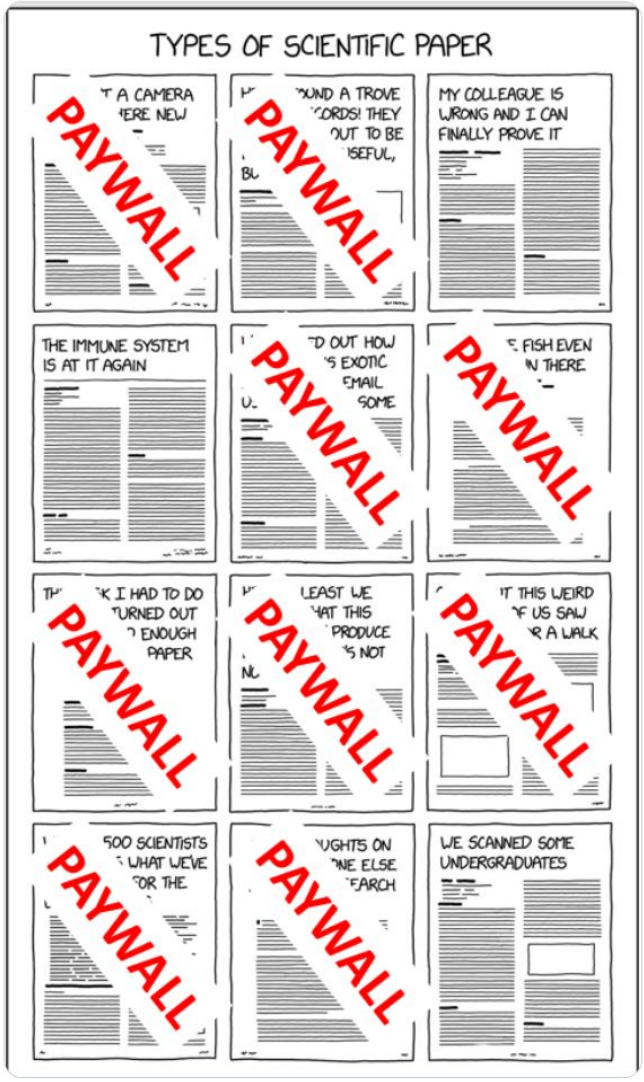
Tweet

Andrew Barnas
@AndrewBarnas

I fixed the "Types of Scientific Paper" meme.



https://en.wikipedia.org/wiki/Alexandra_Elbakyan

https://sci-hub.st/

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https://www.sciencemag.org/news/2016/04/whos-downloading-pirated-papers-everyone

Looking into Pandora's Box: The Content of Sci-Hub and its Usage

https://doi.org/10.12688/f1000research.11366.1

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Open for Science?

*As early as 2010, "Elsevier's scientific publishing arm reported profits of £724 million on just over £2 billion in revenue. That is a **36% profit margin**—higher than Apple, Google, or Amazon posted that year"*

AMERICAN SOCIETY FOR MICROBIOLOGY | mBio®

What Is the Price of Science?

James C. Alwine,[a,b] Lynn W. Enquist,[c] Terence S. Dermody,[d,e,f] Felicia Goodrum[b,g]

https://doi.org/10.1128/mBio.00117-21

Open for Science?

https://paywallthemovie.com/

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Science and “organizing knowledge”

- Most people **cannot access** academic papers
- Rights are often restricted so content **cannot freely be re-used**
- **Data mining** often **hindered**
- Paper often the only published output -> **not reproducible**
  - **Data, code, designs** mostly not available

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The definition of “science”

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  - ~~Communicating and sharing that knowledge~~
  - ~~Testable, reproducible, verifiable~~

kevin.moerman@nuigalway.ie @KMMoerman @Kevin-Mattheus-Moerman

The definition of “open science”

ELSEVIER

Journal of Business Research

Volume 88, July 2018, Pages 428-436

Open Science now: A systematic literature review for an integrated definition

Ruben Vicente-Saez, Clara Martinez-Fuentes

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https://doi.org/10.1016/j.jbusres.2017.12.043

The definition of “open science”

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“ Open science describes the practice of carrying out scientific research in a completely transparent manner, and making the results of that research available to everyone.

Isn’t that just ‘science’? ”

Comment | Open Access

When will 'open science' become simply 'science'?

Mick Watson

Genome Biology 2015 **16**:101
https://doi.org/10.1186/s13059-015-0669-2
Published: 19 May 2015

https://doi.org/10.1186/s13059-015-0669-2

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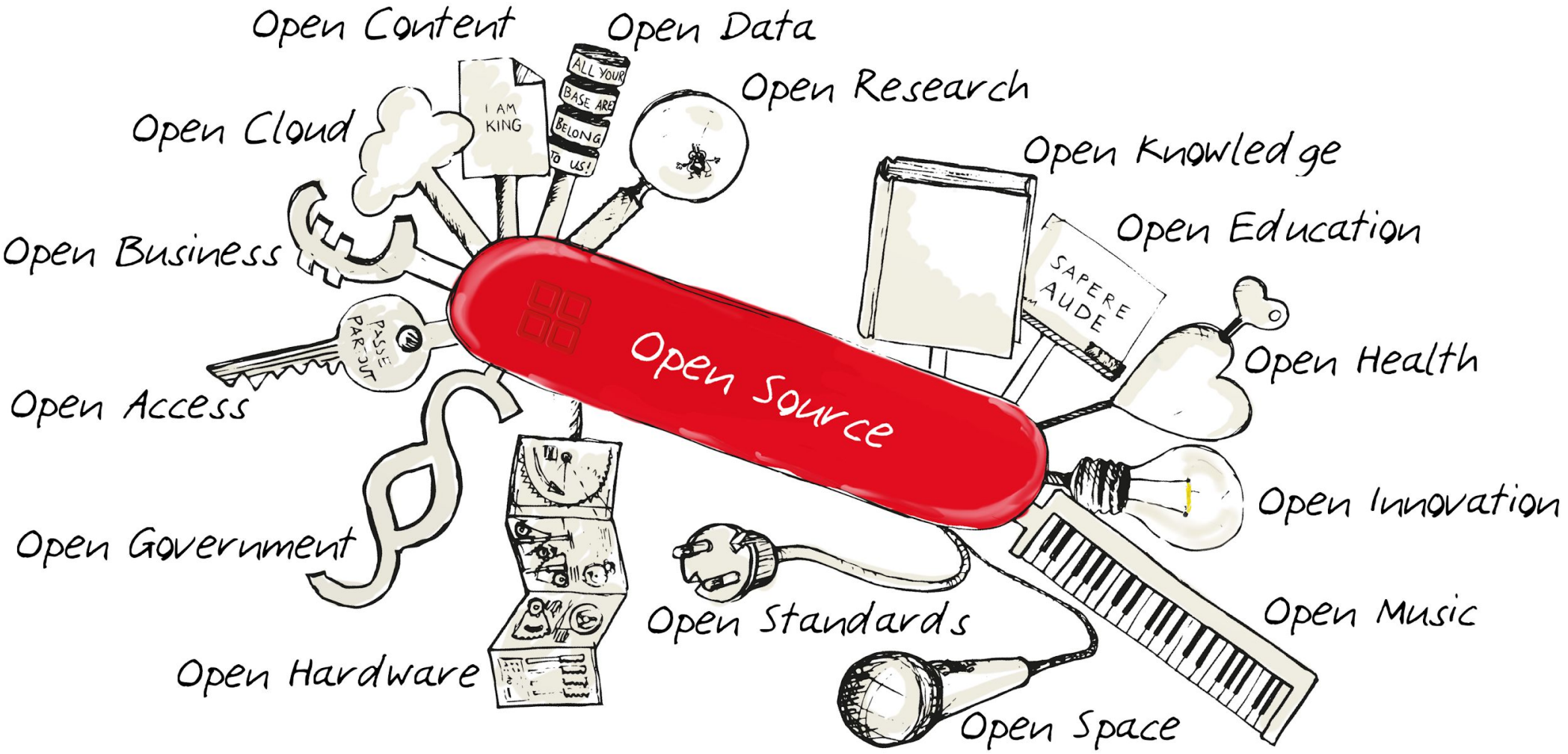
What is open science?



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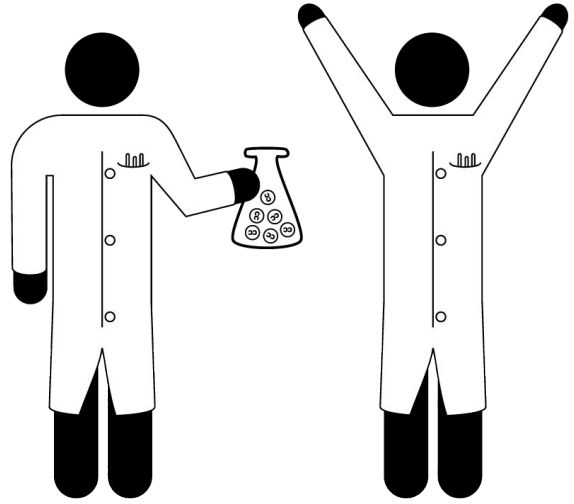
What is open science?

- Open access
- Open source software
- Open data
- Open hardware



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The definition of “open science” = proper/actual science

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- **Builds** and **organizes knowledge** in the form of **testable** explanations/predictions

- In other words:
  - ✓ Generating knowledge
  - ✓ Communicating and sharing that knowledge
  - ✓ Testable, reproducible, verifiable

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Why is open science important?

- How to improve **reproducibility** in science?
- How to **speed up** science?
- How to ensure global **access to knowledge** without barriers

Choose one:

- ☑ Hide/lock away content
- ☐ Openly share all content

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Why is open science important?

- How to improve quality of+access to **education**?
- How can we speed up **health** research?
- How can we speed up **food** research?
- How can we speed up **climate** research?
- How can we improve climate **awareness**?
- How can we improve general **scientific literacy** and decision making?
- How can we improve **trust in science**?!!

Choose one:

☐ Hide/lock away content

☐ Openly share all content

https://sdgs.un.org/goals

kevin.moerman@nuigalway.ie @KMMoerman @Kevin-Mattheus-Moerman

Why is open science important

http://whyopenresearch.org/

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More difficult questions?

- Does open science promote innovation?
- Does open science conflict with patents and commercial deployment?
- Can patenting hinder science?
- Could “open patents” and “open innovation” work?
- What are viable business models for open source/open science?

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Open for Science?

How to become an open scientist

- Ensure open access to papers
  - Publish open access
  - Share pre-prints
- FAIR-ify all research outputs
  - code
  - data
  - hardware
  - ...
- Make your work fully reproducible

kevin.moerman@nuigalway.ie @KMMoerman @Kevin-Mattheus-Moerman

Ensure open access to papers

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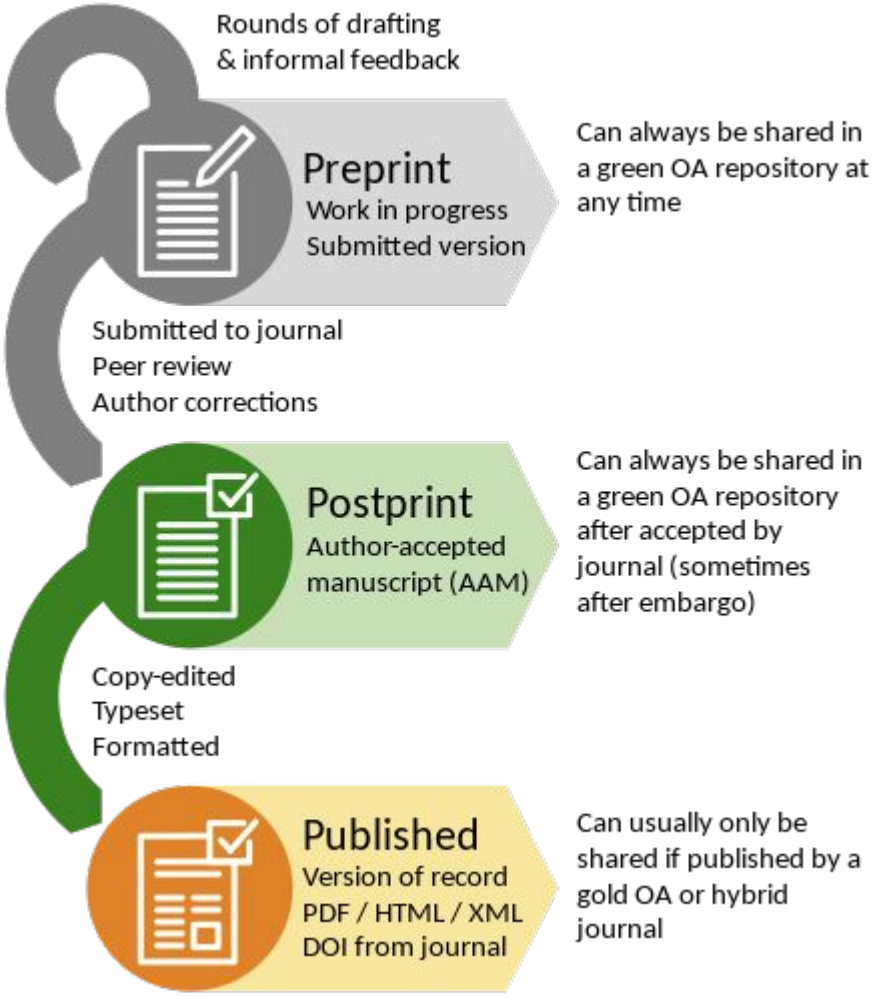
Some confusing terminology

- Preprint
  - Version before peer review
  - AKA **author submitted version**
- Postprint
  - Version after peer review
  - AKA **Author-accepted manuscript (AAM)**
  - AKA **Version of Record (VoR)**
  - AAKA (Annoyingly Also Known As) preprint...
- "e-print"
  - Version after peer review
  - Features journal branding/logo/typesetting
  - AKA journal published version
  - AAKA (Annoyingly Also Known As) preprint...



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Ensure open access to papers

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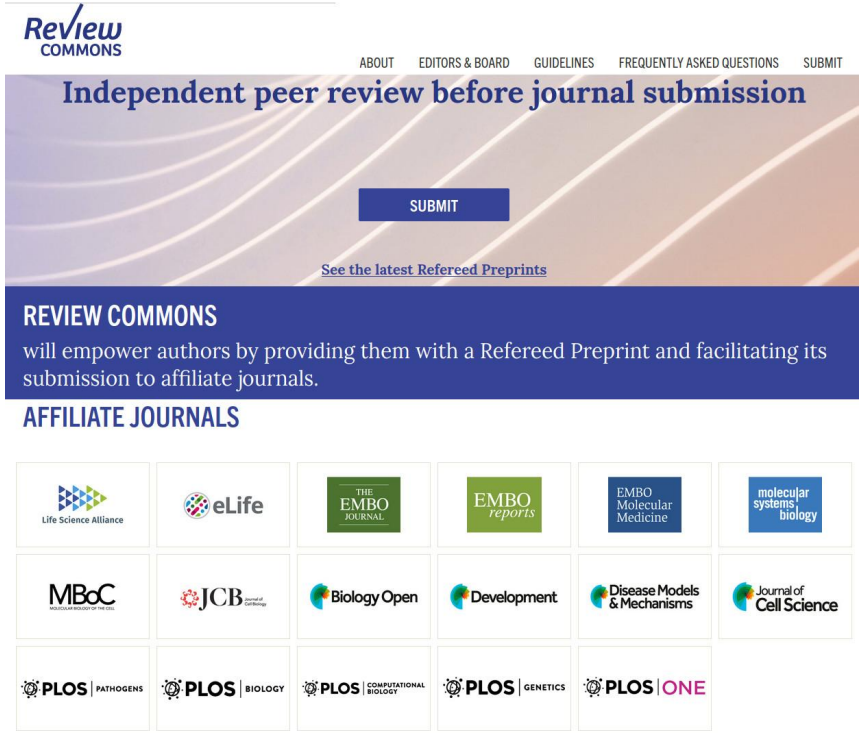
Some more confusing things

- preprints can be viewed as “published”
- preprints can be peer-reviewed prior to journal submission
- “Post-publication peer review” is a thing
  1) Editors do basic check
  2) Work is published rapidly (preprint-ish)
  3) Several iterations of review and updated versions
  4) Final version is labelled as accepted
- Examples:
  - F1000 research https://f1000research.com/
  - Wellcome trust journal https://wellcomeopenresearch.org/
  - HORIZON 2020 journal https://open-research-europe.ec.europa.eu/



https://www.reviewcommons.org/

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Ensure open access to papers

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Types of open access articles

- **Pre-print** – a manuscript draft that has not yet been subject to formal peer review, distributed to receive early feedback on research from peers.
- **Post-print** – a manuscript draft after it has been peer reviewed.
- **Accepted author manuscript (AAM)** – the version of a manuscript that has been accepted by a publisher for publication.
- **Version of Record (VOR)** – the final version of a manuscript, after peer review and processing by a publishers.
- **Eprint** – a digital version of a research document available online for a repository.
- **Hybrid** – a type of journal in which certain articles are made open access for typically a significantly higher price (relative to full OA journals), while others remain toll access.
- **Green OA** – making a version of the manuscript freely available in a repository.
- **Gold OA** – making the final version of manuscript freely available immediately upon publication by the publisher.
- **Gratis OA** – the paper is available to read free-of-charge, though its reuse is still restricted, for example by 'All Rights Reserved' copyright. (source)
- **Libre OA** – the paper is made available under an open licence, allowing it to be shared and reused, depending on which licence is used. (source)
  (Libre and Gratis refer to copyright and licensing restrictions)
- **Diamond OA** – a form of gold open access in which there is no author fee (APC).

http://www.oaacademy.org/types-of-open-access.html

kevin.moerman@nuigalway.ie @KMMoerman @Kevin-Mattheus-Moerman

How about those predatory “open access” journals?

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- Check the **Directory of open access journals (DOAJ)**: https://doaj.org/
- The DOAJ is an independent *“community-curated online directory that indexes and provides access to high quality, open access, peer-reviewed journals.”*
- Ask your librarian

http://www.oaacademy.org/types-of-open-access.html

kevin.moerman@nuigalway.ie @KMMoerman @Kevin-Mattheus-Moerman

Open access over the years

Science
Vol 371, Issue 6524
01 January 2021

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Advertising (PDF)
Classified (PDF)
Masthead (PDF)

FEATURE

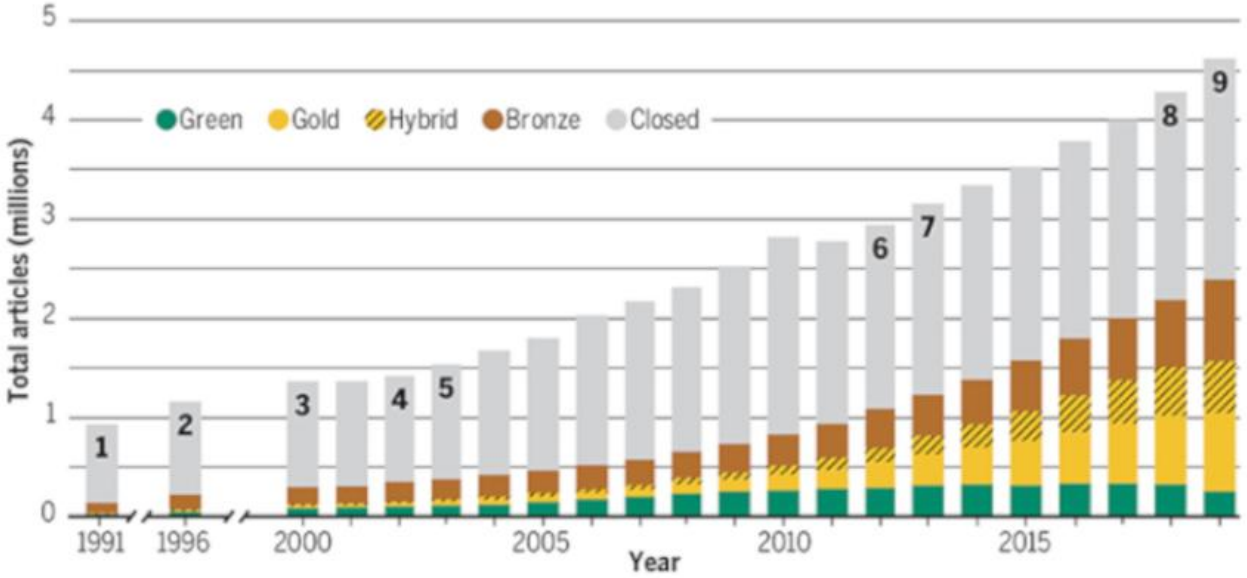
Open access takes flight

Jeffrey Brainard
+ See all authors and affiliations

Science 01 Jan 2021:
Vol. 371, Issue 6524, pp. 16-20
DOI: 10.1126/science.371.6524.16

A gradual opening

In 2017, the percentage of new scientific literature published open access surpassed 50% for the first time. Decisions by authors, publishers, and research funders have helped drive the growth.

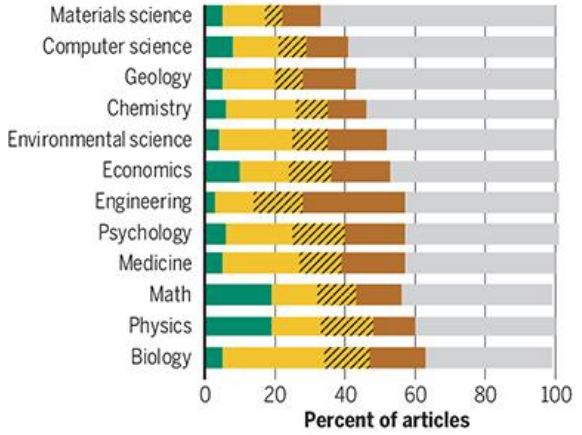


The many colors of open access

A variety of business models have evolved to support the publication of scientific journal articles that are free to read, and their prevalence differs by field. The Curtin Open Knowledge Initiative performed the analyses using the CrossRef, Microsoft Academic, and Unpaywall bibliometric databases.

Differences by discipline

The higher rate of gold open access in biology may reflect higher funding levels that cover publication fees. Physics has a long tradition of posting manuscripts in green open-access repositories.



Green
Authors or publishers deposit articles in a public repository, where they are free to read. But journal embargoes can delay posting. Numbers shown for green are undercounts because they exclude articles that were also published in other categories of open access (below).

Gold
Articles are published with a license making them immediately free to read. Authors or institutions typically pay journals for this service. Gold journals publish only gold articles.

Hybrid
Hybrid journals offer gold open-access publication but also publish other articles behind a paywall and continue to charge for subscriptions.

Bronze
Articles are free to read on publishers' websites, but the papers are not licensed as open access, allowing publishers to place the articles behind paywalls later.

Closed
Journals keep articles behind subscription paywalls.

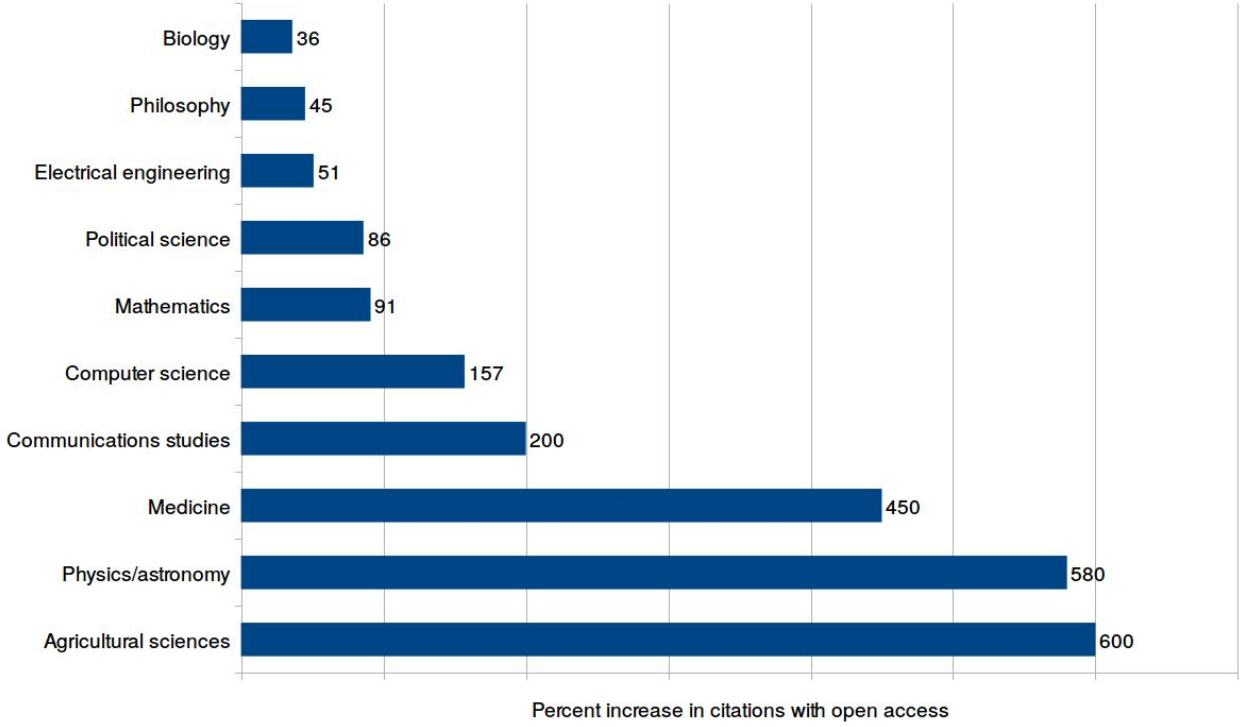
1. **1991** ArXiv, the preprint server that posts papers in physics and other fields, publicly debuts, allowing free online reading of manuscripts.
2. **1996** *The Journal of Clinical Investigation* becomes the first prominent journal to provide its content free online, as public use of the internet increases.
3. **2000** BioMed Central, the first open-access, for-profit scientific publisher, starts.
4. **2002** The Budapest Open Access Initiative defines open-access scholarly articles as allowing the free reuse of the content, with credit to authors.
5. **2003** The Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities expands on Budapest's terms, calling for research findings and data to be deposited in free, public repositories. The *PLOS* open-access journals are launched.
6. **2012** More than 2600 scientists vow not to publish in or referee for journals of the publisher Elsevier, in part because of its opposition to a U.S. National Institutes of Health requirement for green open access.
7. **2013** The White House Office of Science and Technology Policy requires that researchers who publish findings funded by U.S. grants make them open access within 12 months after publication.
8. **2018** Coalition S, a group of foundations and mostly European funders, announces its Plan S, which requires findings published by its grantees to be immediately open access starting in 2021.
9. **2019** Springer Nature and German institutions sign the largest "transformative agreement." Such deals allow institutions' authors to publish open access without paying per-article fees.

https://doi.org/10.1126/science.371.6524.16

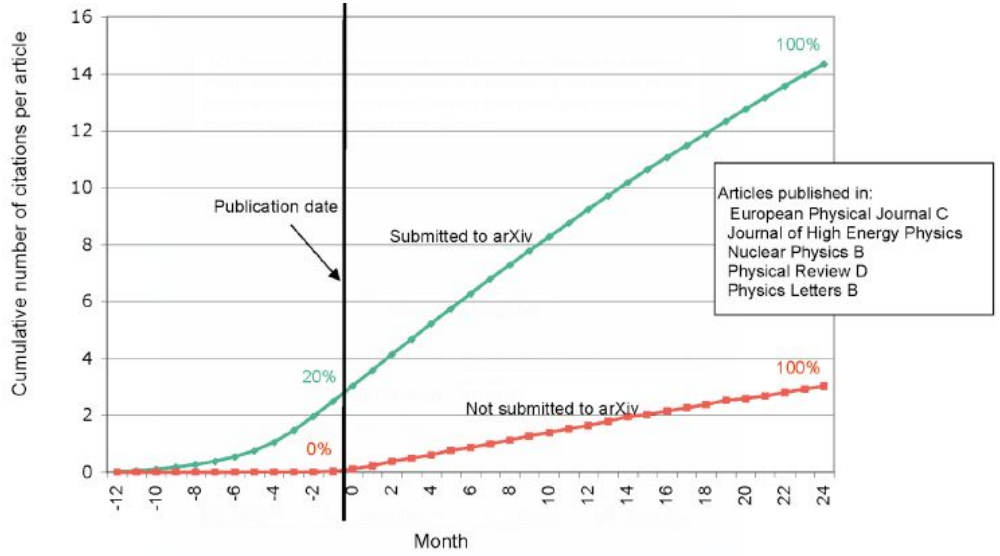
kevin.moerman@nuigalway.ie
@KMMoerman
@Kevin-Mattheus-Moerman

Why should you share preprints?

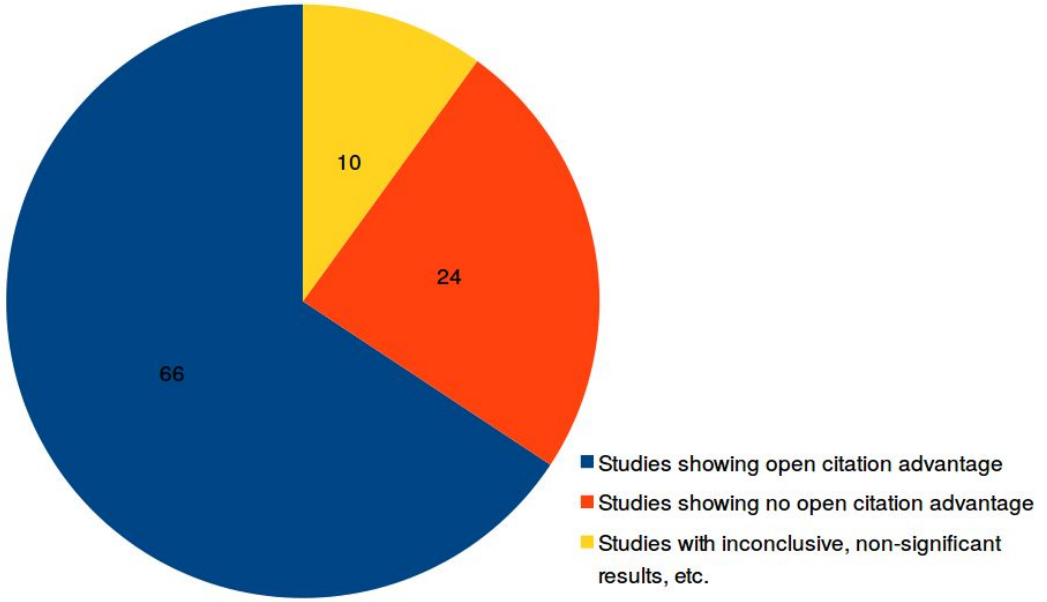
- Enable **rapid** publication
- Enable **open access**
- **Citation advantage**



Source: Data from Alma Swan, 2010. Figure produced by E.C. McKiernan (CC BY).



http://whyopenresearch.org/visibility



http://sparceurope.org/oaca/

kevin.moerman@nuigalway.ie
@KMMoerman
@Kevin-Mattheus-Moerman

Why should you share preprints?

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- preprint and published version seen as “twins”, one being open access version of other
- Open access version offered by search engines
- Citations merged/added up as to a single entity
- Example:
  - Publisher version of a paper: https://doi.org/10.1016/j.ijsolstr.2020.01.019
  - Engineering Archive pre-print: https://engrxiv.org/cfxdr/
  - Google scholar search link

Tip, use unpaywall:
http://unpaywall.org/welcome

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Can we trust preprints or are they “non peer reviewed rubbish”?

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- Many studies conclude changes after peer review are minimal
- >70% of preprints eventually published

“Strikingly, these studies all have the same conclusion: preprints should be considered valid scientific contributions that are comparable to the peer-reviewed literature.”

https://www.the-scientist.com/news-opinion/opinion-the-rise-of-preprints-is-no-cause-for-alarm-68667

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Why should you share preprints?

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- Funding agency recommendations and requirements

"To facilitate prompt dissemination of research findings SFI encourages researchers to deposit preprints ahead of publication. These should be available under CC-BY licences. To this end SFI recognises preprints as valuable research outputs (where these are associated with a digital object identifier [DOI]). "

https://www.sfi.ie/funding/sfi-policies-and-guidance/open-research/SFIs-Open-Access-Policy-V2.1_18.12.2020.pdf

"Does depositing a preprint make my publication compliant with SFI's Open Access policy?
No. SFI encourages researchers to publish preprints however SFI's Open Access policy 2019 requires that the Version of Record (VoR) or Authors Accepted Manuscript, after peer-review must be made openly available. A preprint would not fulfil this criterion."

https://www.sfi.ie/funding/sfi-policies-and-guidance/open-research/Open-Access-FAQs_Dec2020-Final-(1).pdf

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How to share preprints

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1. Make a list check it twice …
   Recommended approach is populate and use your Orcid profile.

2. Check your rights*, and check those twice too
   Check “Sherpa Romeo”: https://v2.sherpa.ac.uk/romeo/

3. Pick a preprint repository e.g. https://engrxiv.org/
   see also this list

4. Upload to the repository

5. Advertise e.g. on social media

6. Update version on the repository e.g. after peer review

7. Link “preprint” DOI with published DOI

https://openaccessclinic.github.io/OA_clinic/

*http://whyopenresearch.org/control

kevin.moerman@nuigalway.ie @KMMoerman @Kevin-Mattheus-Moerman

Open for Science?

How to become an open scientist

- Ensure open access to papers
  - Publish open access
  - Share pre-prints
- FAIR-ify all research outputs
  - code
  - data
  - hardware
  - ...
- Make your work fully reproducible

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FAIR-ify and Share all research outputs

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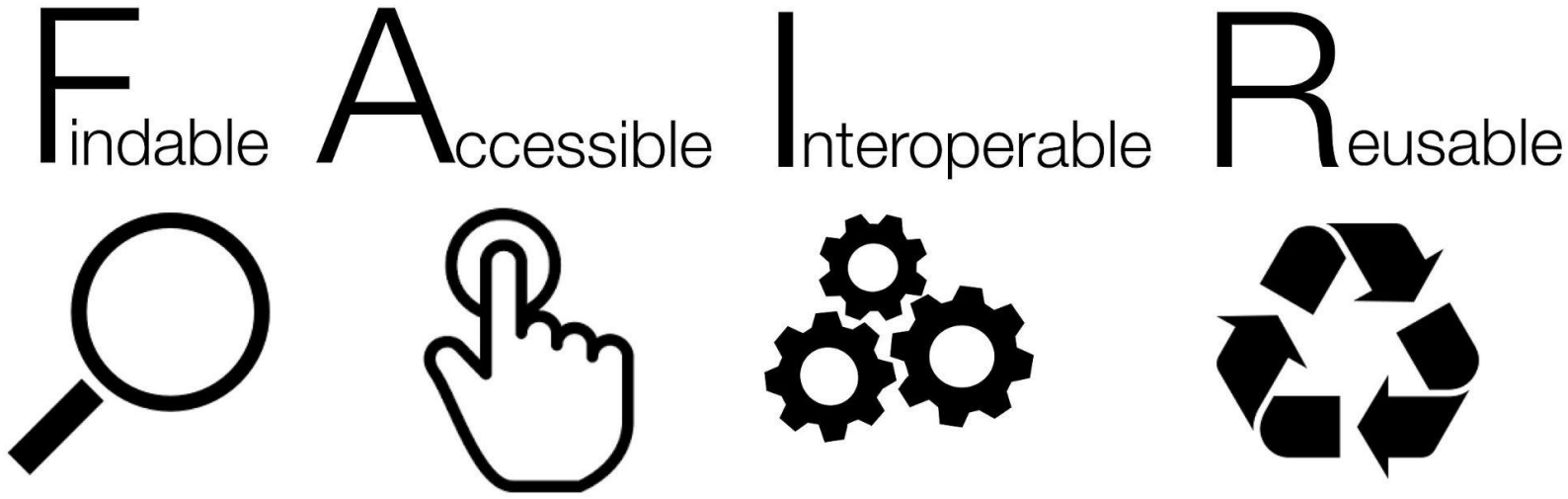
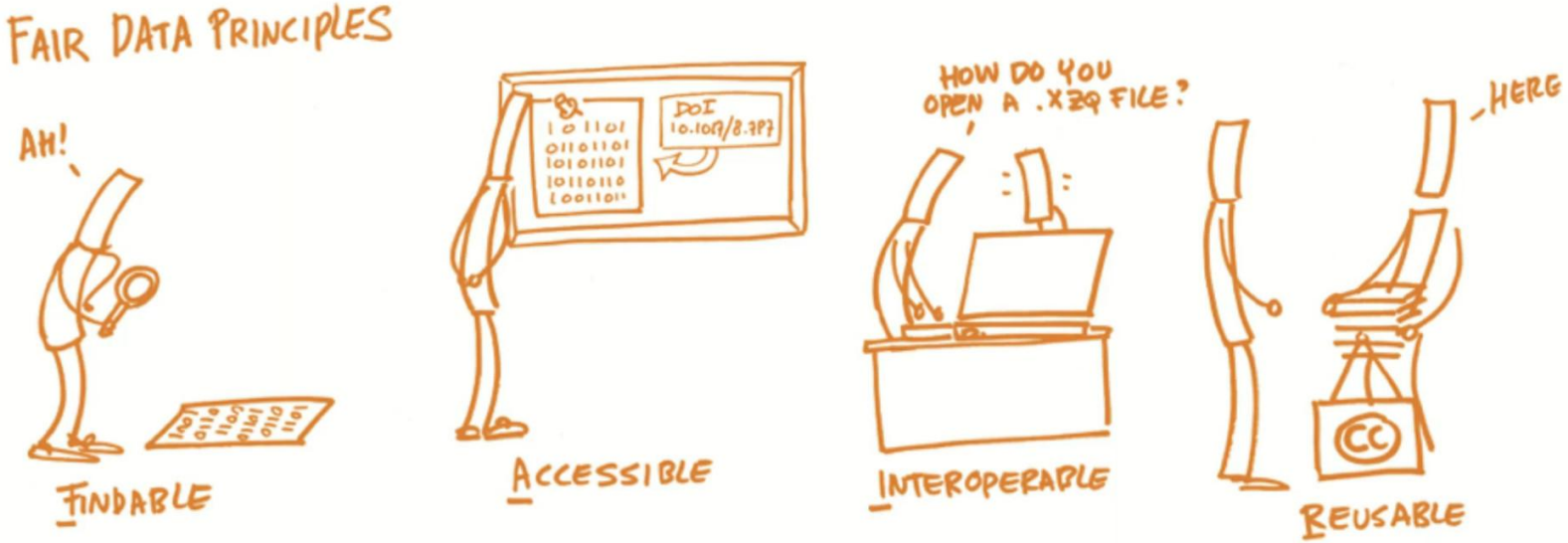


https://en.wikipedia.org/wiki/FAIR_data



https://www.youtube.com/watch?v=R3lu7QlB7lw

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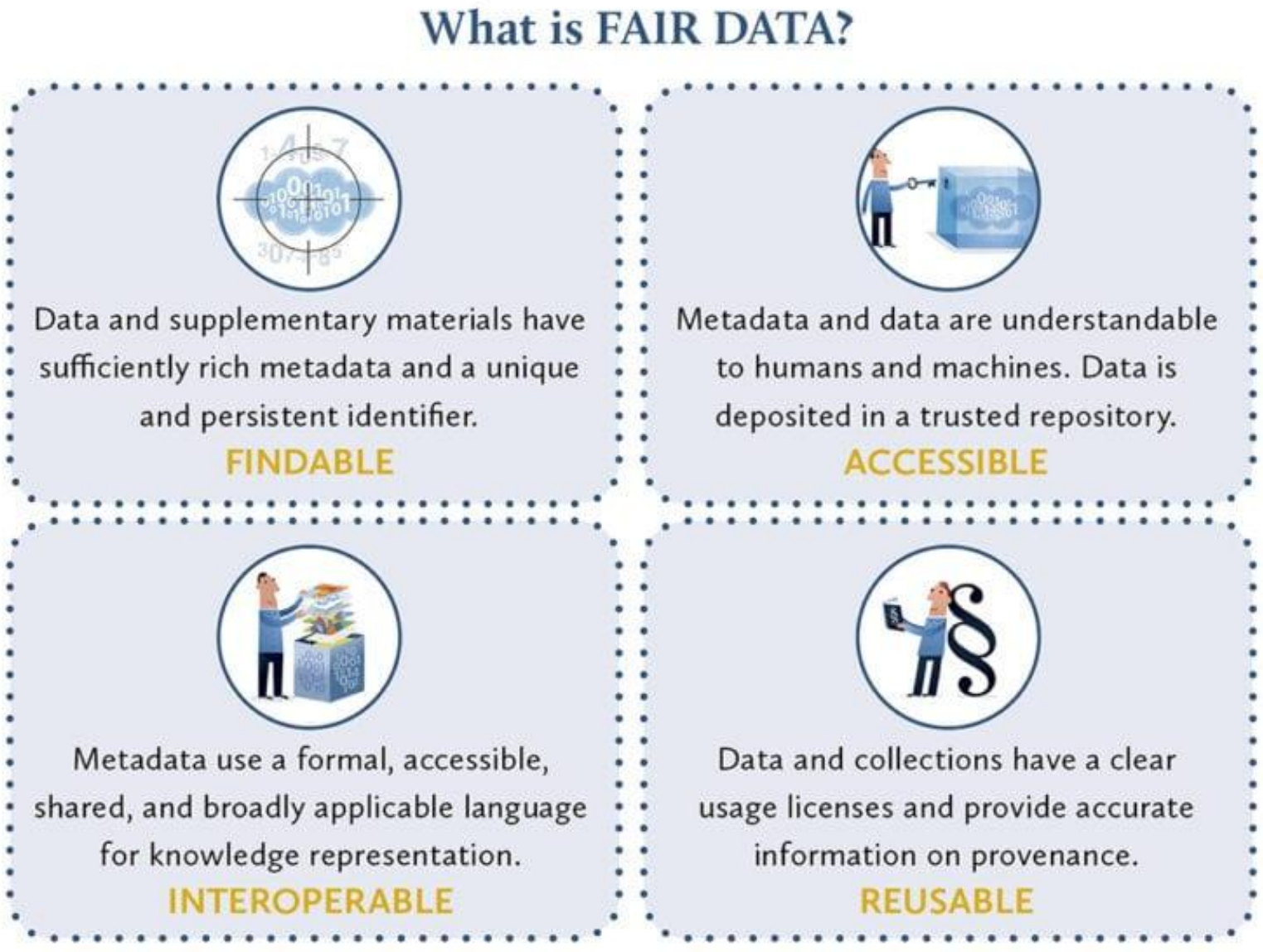

https://libereurope.eu/article/fairdataconsultation/

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What do you mean open?

No license = default copy right ©

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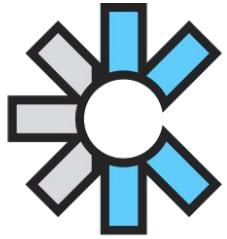

Open Knowledge
Foundation

What license to use?

Two main types of license

- **Permissive "Whatever"**
  - Software: MIT, BSD, Apache 2.0
  - Content: CC0 (public domain), CC BY 4.0

- **Copy-Left "Viral", "Midas touch"**
  - Software: GNU-GPL
  - Content: CC BY-SA 4.0

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Example

- Source files with version control on GitHub
  - https://github.com/3DNIV/3DNIV
- Added licenses for hardware and documentation/images
- Added documentation, contributing guidelines, code of conduct
- Created archived version with DOI on Zenodo (long term stable storage)
- Paper submitted to the journal of open hardware
  - Reviewers had full access to all data/files
- Following acceptance update README on GitHub to show archive link and how to cite the work

Tips to make your code citable:
https://guides.github.com/activities/citable-code/

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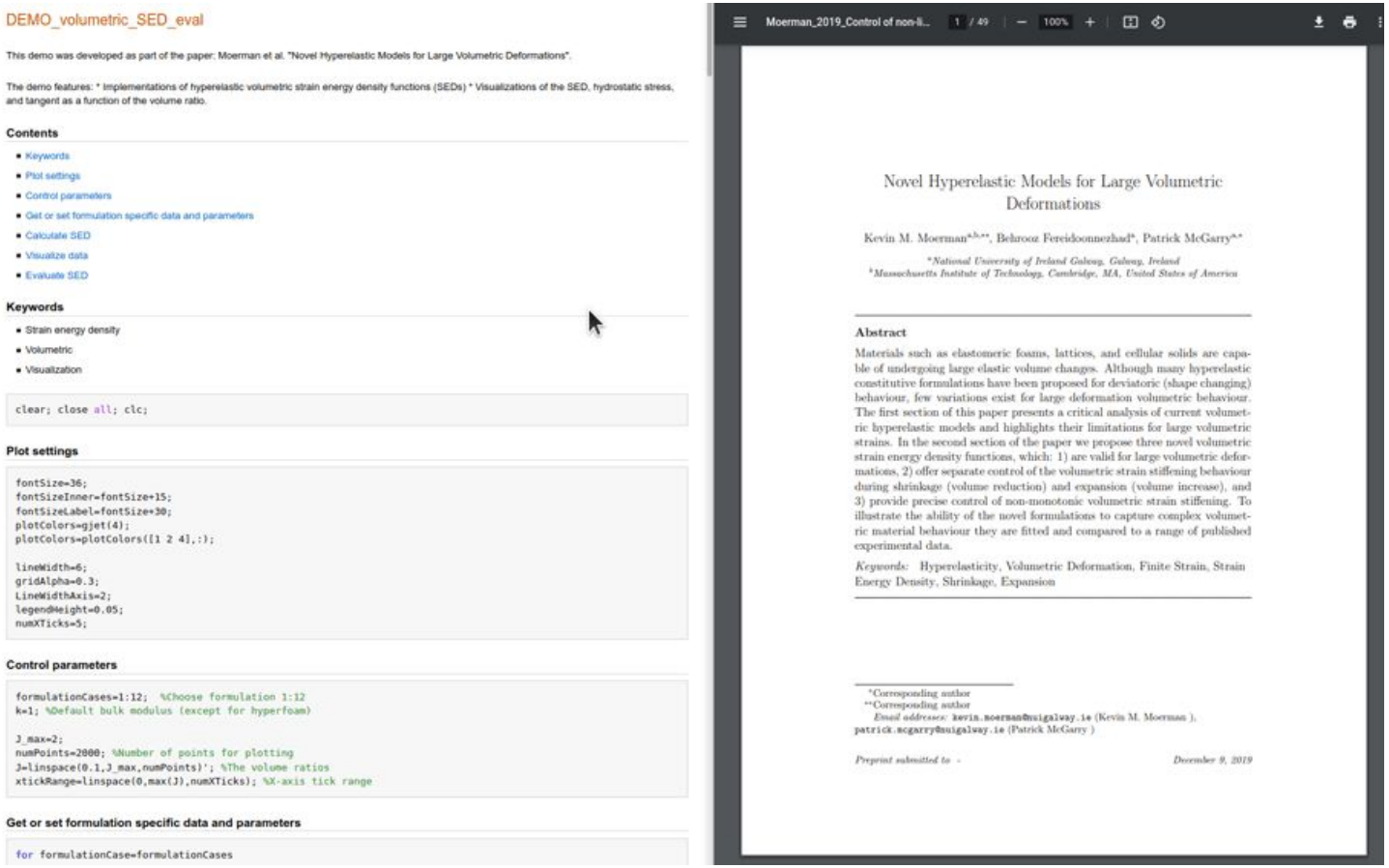
Example

- Open source software available with paper



DEMO_volumetric_SED_eval

This demo was developed as part of the paper: Moerman et al. "Novel Hyperelastic Models for Large Volumetric Deformations".

The demo features: * Implementations of hyperelastic volumetric strain energy density functions (SEDs) * Visualizations of the SED, hydrostatic stress, and tangent as a function of the volume ratio.

Contents

- Keywords
- Plot settings
- Control parameters
- Get or set formulation specific data and parameters
- Calculate SED
- Visualize data
- Evaluate SED

Keywords

- Strain energy density
- Volumetric
- Visualization

```
clear; close all; clc;
```

Plot settings

```
fontSize=36;
fontSizeInner=fontSize+15;
fontSizeLabel=fontSize+30;
plotColors=gjet(4);
plotColors=plotColors([1 2 4],:);

lineWidth=6;
gridAlpha=0.3;
LineWidthAxis=2;
legendHeight=0.05;
numXTicks=5;
```

Control parameters

```
formulationCases=1:12;  %Choose formulation 1:12
k=1; %Default bulk modulus (except for hyperfoam)

J_max=2;
numPoints=2000; %Number of points for plotting
J=linspace(0.1,J_max,numPoints)'; %The volume ratios
xtickRange=linspace(0,max(J),numXTicks); %X-axis tick range
```

Get or set formulation specific data and parameters

```
for formulationCase=formulationCases
```


Moerman_2019_Control of non-li... 1 / 49 100%

Novel Hyperelastic Models for Large Volumetric Deformations

Kevin M. Moerman[a,b,**], Behrooz Fereidoonnezhad[a], Patrick McGarry[a,*]

[a]National University of Ireland Galway, Galway, Ireland
[b]Massachusetts Institute of Technology, Cambridge, MA, United States of America

Abstract

Materials such as elastomeric foams, lattices, and cellular solids are capable of undergoing large elastic volume changes. Although many hyperelastic constitutive formulations have been proposed for deviatoric (shape changing) behaviour, few variations exist for large deformation volumetric behaviour. The first section of this paper presents a critical analysis of current volumetric hyperelastic models and highlights their limitations for large volumetric strains. In the second section of the paper we propose three novel volumetric strain energy density functions, which: 1) are valid for large volumetric deformations, 2) offer separate control of the volumetric strain stiffening behaviour during shrinkage (volume reduction) and expansion (volume increase), and 3) provide precise control of non-monotonic volumetric strain stiffening. To illustrate the ability of the novel formulations to capture complex volumetric material behaviour they are fitted and compared to a range of published experimental data.

Keywords: Hyperelasticity, Volumetric Deformation, Finite Strain, Strain Energy Density, Shrinkage, Expansion

*Corresponding author
**Corresponding author
Email addresses: kevin.moerman@nuigalway.ie (Kevin M. Moerman), patrick.mcgarry@nuigalway.ie (Patrick McGarry)

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kevin.moerman@nuigalway.ie @KMMoerman @Kevin-Mattheus-Moerman

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kevin.moerman@nuigalway.ie

@KMMoerman

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